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ABSTRACT

The learner's existing schema, which is defined here as an integrated structure of knowledge about a given topic, plays a critical role in new learning. Prior to or during learning, appropriate schemata should be activated in order to produce the best learning results. Instructional designers should systematically assess their target audience's pre-existing schemata and activate them in order to produce efficient and effective learning. Strategies available for this purpose include pre-treatment activities that engage learners in thinking about their existing schema prior to instruction and text enhancement to provide cues in learning material. Metaschemata, or students' knowledge about their own schemata, can be important; researchers have suggested that students learn how to evaluate their schemata and modify them as necessary. A list of 31 references is provided. (MES)

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Schema Activation and Pre-instructional Strategies

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Running heading: Schema activation

A number of advocates of schema theory have defined schema differently. Here we considered a schema as "an organized body of knowledge, conceived theoretically as a set of interconnected propositions centering around a general concept, and linked peripherally with other concepts" (Gagne, 1986). According to this definition, a schema may be an integrated structure of knowledge about a certain topic or content. There may exist a great number of schemata representing different aspects of this knowledge, and these schemata of different aspects may have also numerous subschemata representing the sub-domains of this knowledge (Gagne, 1977).

WHAT DOES RESEARCH SAY ABOUT SCHEMA?

1. The learner's existing schema related to the learning topic plays a critical role in new learning.

The learner's pre-existing related schema affects both comprehension and memory. It is well studied that if a learner does not possess a well developed schema related to the learning topic, he or she could not well comprehend or remember the new information. When subjects were provided with related knowledge or with ways to link the new information to the subjects' prior knowledge, their comprehension and memory are greatly improved (Bransford & Johnson, 1972; Royer & Cable, 1975, 1976). Grade school students with appropriate background could learn more than did graduate students and university faculty members who did not have that background, and the subjects with more knowledge about baseball recalled substantially more of the baseball narratives presented than did those with less baseball prior knowledge (Chi, 1978; Chiesi, Spilich, & Voss, 1979; Spilich, Vesonder, Chiesi, & Voss, 1979).

Learners with different background comprehend the same story differently. Given a story from a particular culture, students from a different culture recalled the story distortionally. But their reproduction was skewed toward the direction of their own culture and more information consistent with their own cultures was recalled (e.g., Bartlett, 1932; Steffensen, Joag-dev & Anderson, 1979; Aron, 1985). Asking students of different majoring areas to read an ambiguous passage, the researchers found the subjects' interpretations of the same story were based on their backgrounds and experiences (Anderson, Reynolds, Shallert & Goetz, 1977; Anderson & Acker, 1984).

It has been found that the learner's pre-existing schema affects the whole learning process. First, schema could influence the amount of attention allocated

to a particular type of information. Secondly, it could determine what information is selected for processing. Thirdly, it could intergrate the new information and produce an integrated body of the new and old information learned. And lastly, it guides the process of retrieving to locate the information retained in memory (Brewer & Nakamura, 1984; Alba & Hasher, 1983).

2. Prior to or during learning, appropriate schemata should be activated in order to produce best learning results.

Learners' pre-existing schemata are necessary but not sufficient for new learning. More important is the activation of the schemata prior to and during learning. Research literature suggests that the first stage of schema function in learning process is schema recognition (Graesser & Nakamura, 1982) or schema access (Cunningham, 1984). Before a learner begins to read a passage, he or she must recognize an appropriate schema for that passage. When no cues are provided to help activate such a schema, the learner has to induce one. The difference of comprehension and memory between the conditions in which an appropriate schema is activated and those in which no schema is activated has been found substantial. For example, students given a context before reading an ambiguous passage greatly improved their comprehension and recall because they identified, and therefore activated, an appropriate schema (Bransford & Johnson, 1972). Similar results have been reported with different ways to activate students' prior schemata such as context information (Schallert, 1976; Townsend, 1980), titles (Kozminsky, 1977) and pre-passage questions (Wilhite, 1983). Furthermore, students with different types of schemata activated would remember different types of information. For example, the learners with a home buyer perspective recalled more items related to the value of the house, while those with a burglary perspective recalled more items which are interesting to a burglar. When these subjects switched their perspectives, they recalled items that were consistent with the new perspectives and that they failed to recall before (Anderson, Pichert, and Shirey, 1983).

On the other hand, activating an inappropriate schema sometimes has negative effects on learning. For example, when students were given inappropriate contextual information, they recalled less information than did those who were given no contextual information (Townsend, 1980). The mismatch of schema and the schema shift produce difficulties in comprehension.

It seems clear that appropriate schema should be

activated in order to produce the best learning results. This can be done in a number of ways in the instructional process or built into the instructional materials designed and developed. We will return to this later.

ASSESSING LEARNER'S PRE-EXISTING SCHEMATA

The learners' pre-existing schemata and the activation of them are so critical in learning, as briefly described previously, that the instructional designers have to take into account the schemata the target audience already has and the ways to activate these schemata. In order to do so, the instructional designer has to assess the pre-existing schemata prior to designing effective instruction.

The assessment may not be a formal measurement in lots of times. A designer may have been working with a specific student population for a long time, and he or she has some clear idea about his target audience's prior knowledge (schemata). Sometimes, the designer may estimate the learners' schemata by analyzing their general background such as cultural heritage and their native language, and appropriate activities can be arranged to help activate students' pre-existing schemata prior to or during learning.

However, to assess the learners' existing schemata, the best way is to have the students demonstrate how much and how well they know about a particular topic. In this aspect, not many systematic ways have been developed. Langer (1980, 1984) designed and tried out an approach to measure learners' prior knowledge.

According to Langer (1980), a learner's prior knowledge could have three different levels. The lowest level is called Diffused Organized Knowledge. At this level, the learners can only report personal experience or tangential cognitive links. The second level is Partially Organized Knowledge. At this level, the learner can provide examples of a concept and define it in terms of its main characteristics. The highest level of prior knowledge is called Highly Organized Knowledge. Learners at this level can elaborate the concept provided to its superordinate and related concepts and define the concept precisely. Langer (1981, 1984) and others (e.g., Hare, 1982) used and validated this measure in predicting students' comprehension and recall.

Applied in our instructional design process, the designer may need to identify and describe the learners' pre-existing schemata following the structure suggested

by Langer in the learner analysis stage, and in the design/development stage, build in instructional treatments addressed to the audience differently but corresponding with the three levels of prior knowledge. For example, if the learners' prior knowledge is at a lower and diffused level, their schemata may be too weak to be sufficient for new learning. More background information should be provided to help students comprehend the new information. If the learners' schemata are at the highest level, cues such as proper titles and/or illustrations would be enough to help students connect the new learning with their existing schemata.

ACTIVATING STUDENT EXISTING SCHEMATA

Knowing the status of the learners' schemata is not enough to develop effective instruction. The learners' schemata have to be activated and connected to the new learning in order to have positive instructional results as described previously. Schema activation can play a great role in this the information process through guiding learners to select, abstract, interpret, and integrate incoming information (Alba & Hasher, 1983). Though no systematic strategy has been developed to activate students' schemata, various techniques have been tried by the researchers and field instructors.

Pre-treatment activities. One way to activate learners' existing schemata is, prior to instruction, to engage the learners in thinking about their existing, related schemata and in relating them to the new learning. Langer (1984) describes her program of pre-learning activities called PREP (Pre Reading Plan). In PREP, teachers select key words or phrases (superordinated concepts from the target passages) that are central to the understanding of the passage and try to engage students to review what they already know about the target topic. This program consists of three phases:

(1) Initial associations with the concept selected
-- "Tell me anything that comes to mind when"

(2) Reflections on initial associations -- "What made you think of ..."

(3) Reformation of knowledge -- "Based on our discussion, have you had any new ideas about ... "

Through this method, the learners' whole schemata at various levels could be activated systematically. Based on this program, Melendez and Pritchard (1985) developed a set of three questions to guide foreign

language students to relate the target reading text to their native culture and language, and produced positive results. Langer (1984) reported that because the pre-reading activity significantly raised the available prior knowledge, it significantly improved student comprehension of moderately difficult passages.

Another pre-instructional treatment was developed by Cunningham (1984). In Cunningham's program called schema-access/purpose setting, the teacher provides students, prior to reading, with a set of questions in a workbook format that would remind students of what they have known or experienced about a topic and that simultaneously would help students to discover something they did not know or were unaware of about the topic. For example, to the topic, "Moving to a new school", several questions can be asked in a workbook such as: Have you ever moved to a new school? Who do you know who moved to a new school? What might some advantages of moving be? What might some problems be? These questions can help students recall their experience about moving or imagine what would happen to a moved students. As a result, the learners' previously acquired knowledge and experience are activated and used in the new learning.

Text enhancement (Gagne, 1986). Another way to help activate students' pre-existing schemata is to provide cues in learning materials or instructional process. Gagne discusses a number of ways of enhancing text display of computer-based instruction including insertions, verbal elaborations, text variations and mapping. Using these techniques, the "slots" of a schema represented by the learning material are highlighted, or students' pre-existing knowledge is directly drawn to elaborate new concepts.

Other researchers have used various cues in reading materials to help activate student prior knowledge. Contextual information (e.g., Norman, Gentner & Stevens, 1976; Schallert, 1976; Townsend, 1980) has been found valuable in helping students form a mind set toward the topic to be learned, that is, to help the students form an expectation of the type of incoming information and readily process the information in the intended way. Several methods can be used to accomplish this. One is to provide a set of pre-passage questions asking the students about the context of the reading materials. Another one would be to give the reading material an appropriate title which indicates the context of the material to be read. One important way is to incorporate students' existing schemata into the instructional process so that the materials are close to their experiences and knowledge. For example, in the

instructional materials or classroom teaching practice, examples familiar to the students should be used to elaborate concepts rather than using unfamiliar context (Ross, 1983).

Metaschemata. Student knowledge about their own schemata related to a particular topic may be very important. Little is known regarding metaschemata, but a number of researchers have suggested that students learn the ways to evaluate their own schemata and to modify them as necessary (e.g., Gagne & Dick, 1983; Norman, Gentner & Stevens, 1976).

In summary, schema is a critical factor that should be considered in the instructional design process. To a large extent, the pre-existing schema related to a particular learning topic influence learners' processing and retention of new information. Instructional designers should systematically assess their target audience's pre-existing schemata and activate them in order to produce efficient and effective learning. To approach this, various strategies available can be applied prior to instruction, during instruction and in the materials designed and developed. Furthermore, the activation mechanics should be addressed to appropriate schemata so as to result in the best learning results.

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